serious defect that references and authorities are imperfectly given, so that the work reads like a book meant to be used in cramming men for examinations and not like a real introduction to the subject. Dr. Ernest Playfair has performed the difficult task of translation admirably.

HIGHER DYNAMICS FOR ENGINEERS.

A Treatise on Dynamics, with Examples and Exercises. By Prof. A. Gray, F.R.S., and Dr. J. G. Gray. Pp. xvi+626. (London: Macmillan and Co., Ltd., 1911.) Price 10*s*. net.

THE preface to this book states that it is intended "to provide a discussion of higher dynamics suitable to students of engineering, physics, or astronomy." It is doubtful whether it would be a good book for intending students of astronomy, but it will be useful both to physicists and to students of applied mathematics as supplementing other treatises, and is an excellent book for an engineer whose mathematical equipment is sufficient to follow the reasoning.

Examples of problems which occur in engineering or are of special interest to engineers appear early, and continue right through the book; in addition to those included in the majority of treatises (including trajectories in resisting media) may be mentioned resistances of water to ships, steering of ships, brakes of trains, motion of wheeled vehicles, and dynamics of self-propelled vehicles. The conditions which contributed to the Salisbury accident of 1906 are fully dicussed, and although there is a misprint in the figure used in this discussion, and a misprint of $\tan^{-1}$ for $\sin^{-1}$, the results, both algebraic and arithmetic, are correct. The reasons why a blacksmith uses small and large hammers for different purposes (p. 399) do not appear in most treatises on dynamics!

Although elementary dynamical questions like the above are clearly and fully discussed, elliptic integrals are introduced where thought to be practically useful (as in the pendulum), and there is a clear and full discussion of three-dimensional rigid dynamical problems, mainly of a practical nature. The change in the ordinary figure (art. 9) by which the usual right-handed screw notation is made consistent with the traditional forms of Euler's and kindred three-dimensional equations will commend itself equally to teachers and students of dynamics, though the figure might with advantage have been repeated in the later chapters. The principle of this article is claimed in the preface to be comparatively new, but seems not to differ from that practically used by the standard treatise of Routh. The principle is, however, expressed clearly and made good use of in the chapter on gyrostats, which should be specially useful to engineering students as giving a clear and practical explanation of a subject generally regarded as difficult. The discussions of gyrostatic control of the rolling of ships, the monorail, the gyrostatic action of turbine-driven steamers, and other questions are very full, while examples, such as those on self-steering torpedoes and on the effect of the rotation of the earth on the aiming of artillery, give practical illustrations of the value of the higher parts of the subject. The gyrostats in Thomson and Tait § 345, x., are reproduced, and partially discussed; but the discussion is not quite full enough, and it may be remarked that the azimuthal equilibrium in case 3 is said to be made stable by rotation, which is contrary to Thomson and Tait's result, and seems to be incorrect.

Lagrange's equations, though foreshadowed early in the treatise (p. 112), are not introduced seriously until chapter x.; they might have been of assistance to students in the two preceding chapters, in which tops, gyrostats, motion about a point under no forces, and motion of hoops are discussed, but the authors certainly do very well without the aid of these equations. Chapter x., which gives the transformations of Hamilton and Appell of the general equations, will be more useful to students of physics than to engineers or engineering students; but in all the rest of the book except in chapter v., which deals with orbits, the needs of engineering take a prominent place. Chapter v., which is presumably written for the astronomer, scarcely differs sufficiently from the traditional treatment to be of much use to him, although some little-known theorems by G. W. Hill and others are included in it.

A rather easy chapter on some quite simple statical properties comes as a surprise at the end of the book, following the advanced chapters on rigid dynamics, and is scarcely in keeping with the character of what precedes. But the general arrangement and presentation of the subject is likely to be most useful to all engineering students of sufficient mathematical capacity, and to many students of physics and of applied mathematics.

There are a few misprints, in addition to those noted above, but none which could not be readily corrected. A little revision of pp. 392 and 393, and a re-wording of the second line of p. 137 might be useful in subsequent editions. The results of the examples, so far as the reviewer has verified them, seem to be correct.

APPLIED MICROBIOLOGY.

Einführung in die Mykologie der Genussmittel und in die Gärungsphysiologie. By Prof. Alex. Kossowicz. Pp. viii+211+2 plates. (Berlin: Gebrüder Borntraeger, 1911.) Price 6 marks.

THIS work, a companion volume to the author's "Mycology of Foodstuffs," deals with those adjuncts of the table the use of which, although not strictly necessary, and classed, and for the most part taxed, as luxurious, has become so firmly established that few of us are sufficiently Spartan entirely to avoid it. Fermented beverages, both alcoholic and (reputedly) non-alcoholic, vinegar, mustard (of the French variety), vanilla, cocoa, coffee, tea, and the post-prandial cigar are all submitted to processes of fermentation at one stage or other of their progress towards that culmination of perfection which delights the connoisseur. It is with the organisms concerned,

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the changes produced, and the diseases to be guarded against in the subtle preparation of these different articles of daily use that the author is concerned.

The treatment of this varied assortment of subjects is somewhat condensed, no doubt from limitations of space, but the reader is supplied with a considerable amount of information about each, much of which is extremely interesting. In every case a useful outline of the method of manufacture or preparation is given, at all events as regards that stage of it in which fermentation is involved.

The treatment of the various processes dependent on alcoholic fermentation is too condensed to be entirely satisfactory, although all the essential points are touched upon. A somewhat disproportionate amount of space is devoted to the discussion of the "bios" question, which, however interesting in itself, is not of supreme technical importance. The fact, first observed by Wildiers, that yeast when inoculated in small amount into a synthetic medium fails to grow, was explained by him as due to the absence from such a medium of some specific material essential for yeast growth, and to this unknown substance he gave the name of bios. It is probable that the explanation advanced by Pringsheim, that yeast can only gradually adapt itself to the assimilation of the nitrogen of such media, is correct, although it seems also to be true that different yeasts possess very varying degrees of adaptability. In view of these facts it is remarkable that Pasteur was so successful in his classical experiments on the growth of yeast in simple media, and it has been suggested that this success was due to the presence of mycoderma in his yeast, the presence of this organism having been found to enable yeast to grow freely in media such as he employed.

The function of fermentation processes in the preparation of alcoholic beverages and vinegar is, of course, the fundamental one of producing the essential constituent—the alcohol or acetic acid—by biochemical change from the materials present in the liquid employed. When we turn to the other substances on our list, however, this is found to be by no means the case. Coffee consists of seeds or beans which occur firmly embedded in an integument, the whole forming the fruit of the plant. The chief function of the fermentation in this case seems to be the loosening of this integument, so that the beans can readily be separated and dried, and this is effected by the decomposition of a viscid layer immediately surrounding the seeds, an alcoholic fermentation of this material occurring first, and being followed by a stage in which acetic acid is produced, a considerable rise of temperature accompanying the change.

Black tea and tobacco, on the other hand, are submitted to processes of fermentation the object of which is the attainment of the flavour and aroma upon which their value depends. In both cases opinions are divided as to the exact nature of the process. On one hand it is maintained that micro-organisms are essential agents and it has even been proposed to impart the aroma of the finer qualities of tobacco to inferior material by inoculation with the appropriate organisms. On the other hand it is contended that the change is enzymic, due to the decomposition of glucosides and to oxidation processes, although it is admitted that organisms are present and may have some secondary and minor effect on the result. In the case of cocoa, too, some doubt exists as to the relative share of plant enzymes and extraneous organisms in the fermentation to which the beans are submitted, and which results in a dry bean of good flavour and colour.

The preparation of mustard has been specially investigated by the author. A mixture of ground white and black mustard seeds (respectively containing sinalbin and sinigrin) is treated with 2·5 per cent. acetic acid, along with salt and a mixture of spices. The chief change which occurs is the decomposition of the glucosides with the liberation of the mustard oils. The mass is then left for a few days, ground and bottled. Since the glucosides of mustard are remarkably resistant to the attack of most bacteria and the mustard oils are strong inhibitants of bacterial growth, although not particularly powerful antiseptics, it might be thought that mustard would be free from liability to bacterial "disease." This is, however, not the case, and the author has isolated two species of sporing bacteria (*B. sinapivorax* and *B. sinapivagus*) which are capable of decomposing the mustard glucosides, in one case with evolution of gas, and occasionally cause serious loss to the manufacturer. The book, which, as will be seen, deals with an extremely interesting subject, is provided with a good index and bibliography, and is adequately illustrated.

A. HARDEN.

SOME RECENT WORKS ON MATHEMATICS.

(1) *Lehrbuch der Mathematik für Studierende der Naturwissenschaften und der Technik: Einführung in die Differential- und Integralrechnung und in die analytische Geometrie.* By Prof. G. Scheffers. Zweite Auflage. Pp. viii+732. (Leipzig: Veit and Co., 1911.) Price 18 marks.

(2) *Die Integralgleichungen und ihre Anwendungen in der mathematischen Physik.* By Adolf Kneser. Pp. viii+243. (Braunschweig: Fr. Vieweg und Sohn, 1911.) Price 6 marks.

(3) *Untersuchungen über Oszillationstheoreme.* By Dr. phil. Otto Haupt. Pp. 50. (Leipzig and Berlin: B. G. Teubner, 1911.) Price 2 marks.

(4) *Die partiellen Differentialgleichungen der mathematischen Physik, nach Riemann's Vorlesungen in fünfter Auflage bearbeitet.* By Prof. Heinrich Weber. Erster Band. Pp. xviii+528. Zweiter Band. Pp. xiv+575. (Braunschweig: F. Vieweg und Sohn, 1910, 1912.) Price 12 and 15 marks.

(5) *The Dynamical Theory of Sound.* By Prof. Horace Lamb, F.R.S. Pp. viii+303. (London: Edward Arnold, 1910.) Price 12*s.* 6*d.* net.

(6) *A Logical Notation for Mathematics.* By Robert T. A. Innes. Pp. 3. (Cape Town: S.A. Association for the Advancement of Science, 1911.)

(7) *Vorlesungen über Variationsrechnung.* By Prof. Oskar Bolza. In drei Lieferungen. Pp. iv+iv+x+706+10. (Leipzig and Berlin: B. G. Teubner 1908–9.) Price 19 marks.

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